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691 MANUFACTURE
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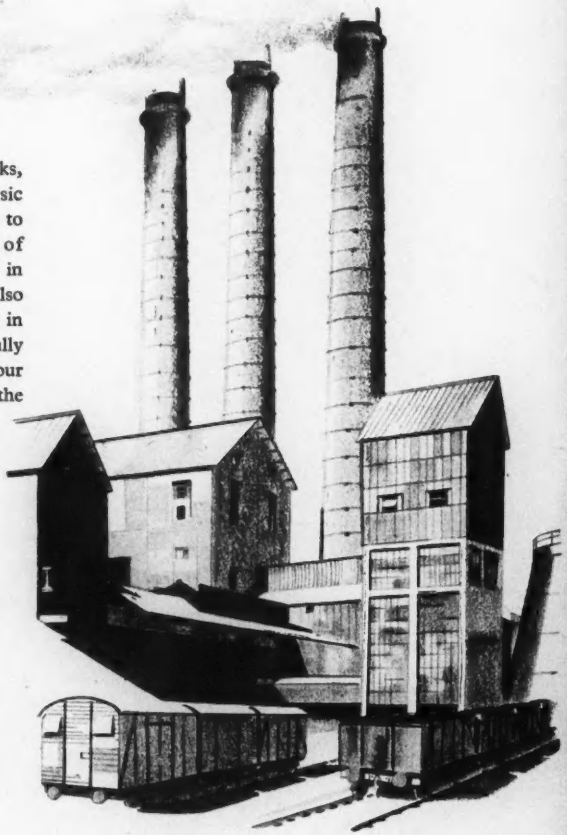

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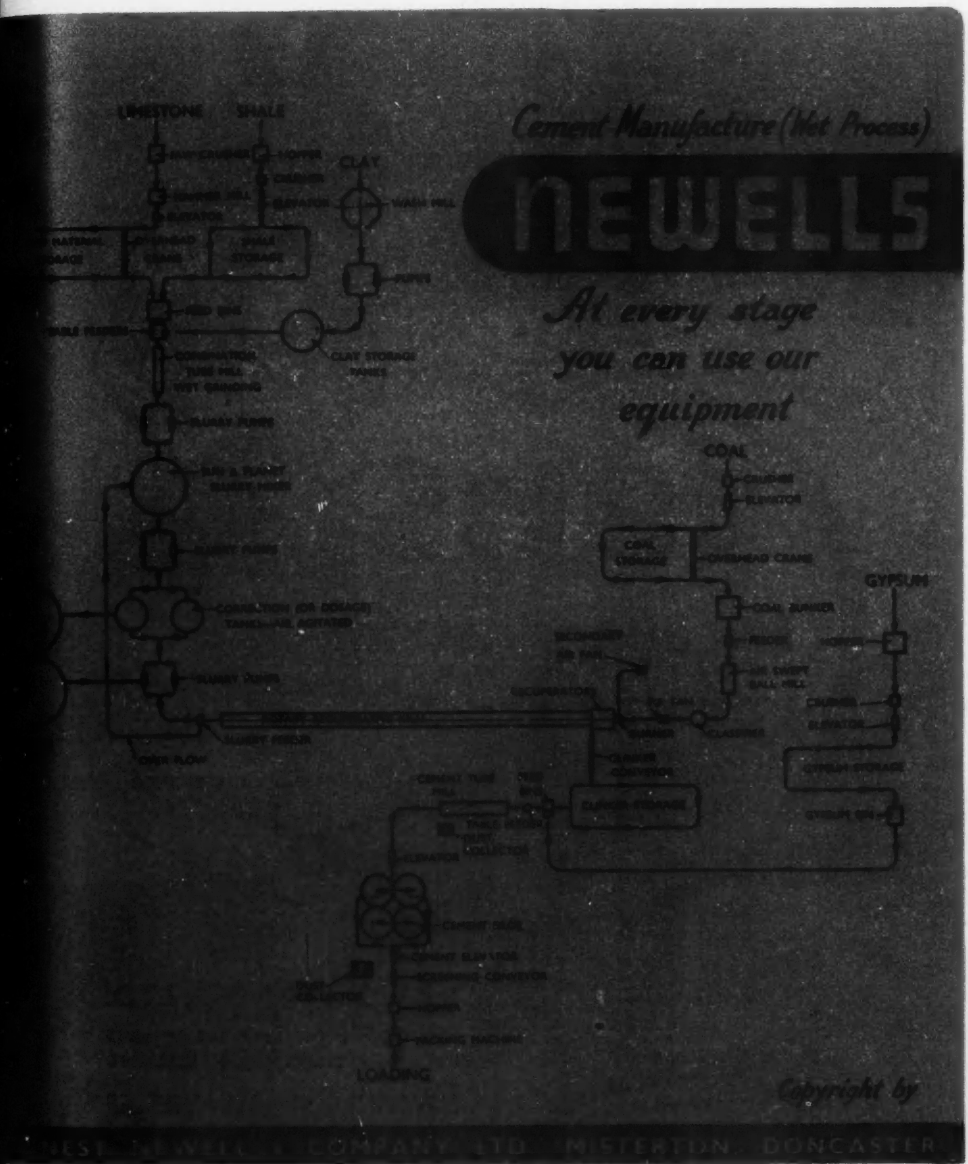

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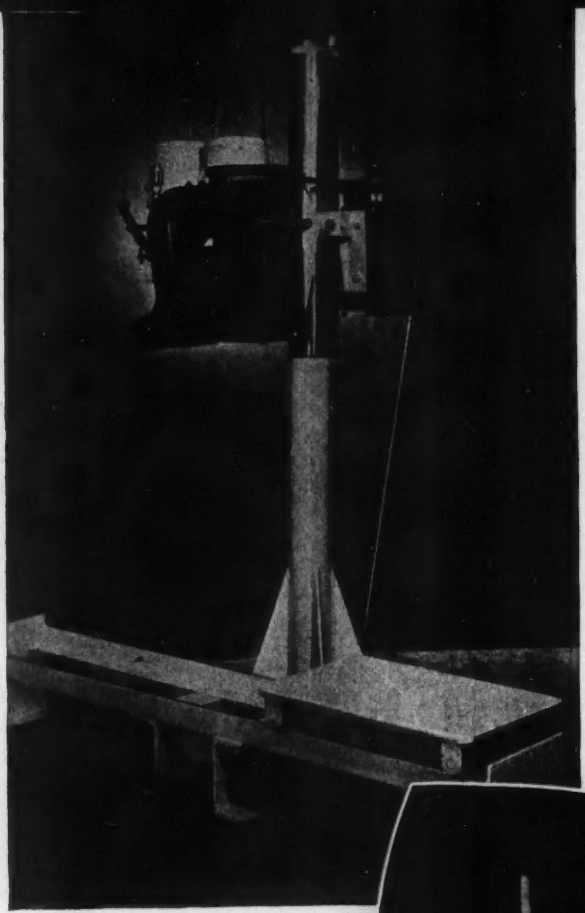

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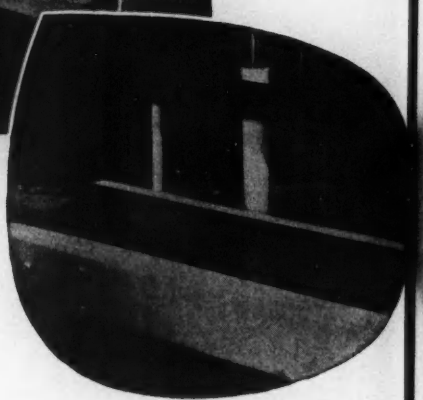

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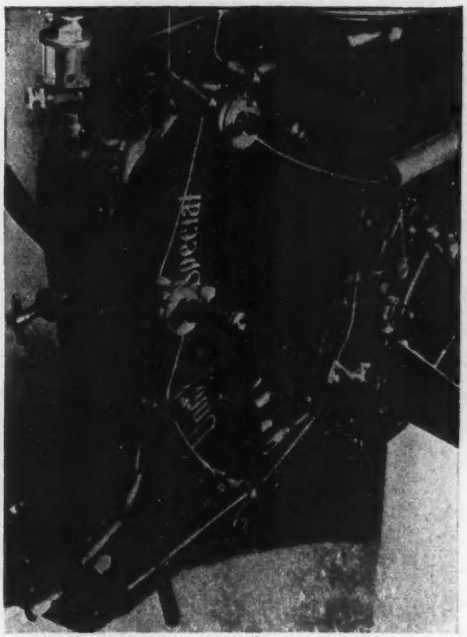

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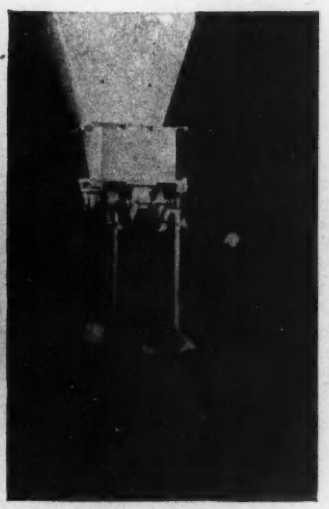

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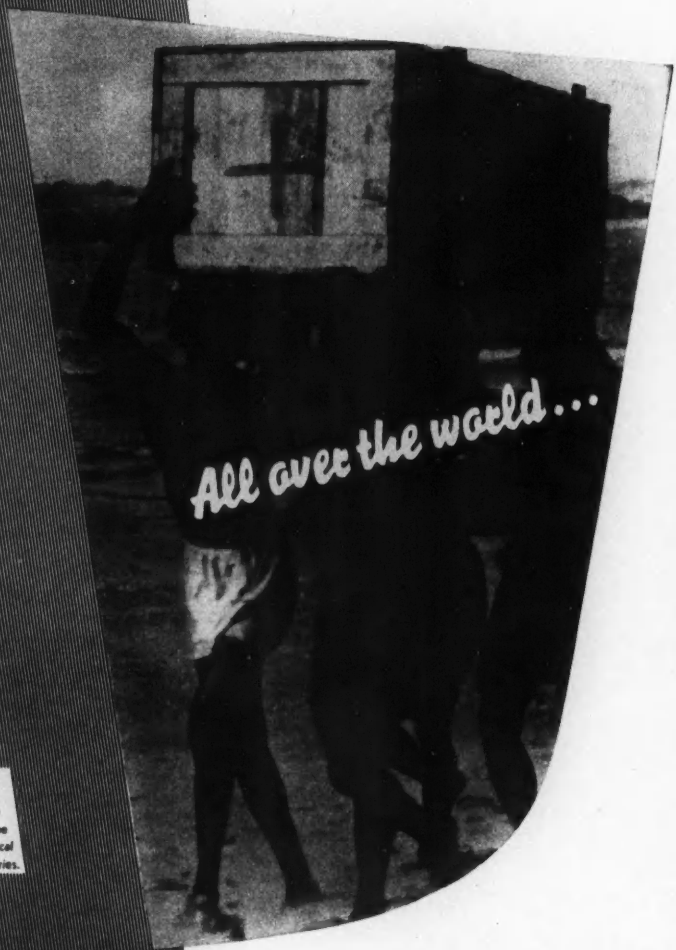

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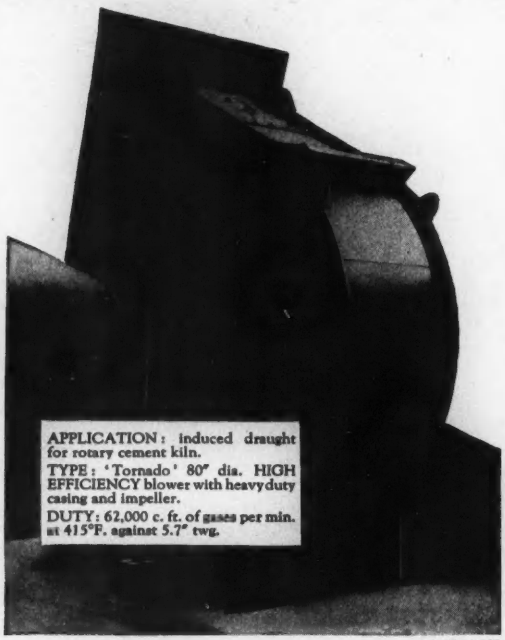

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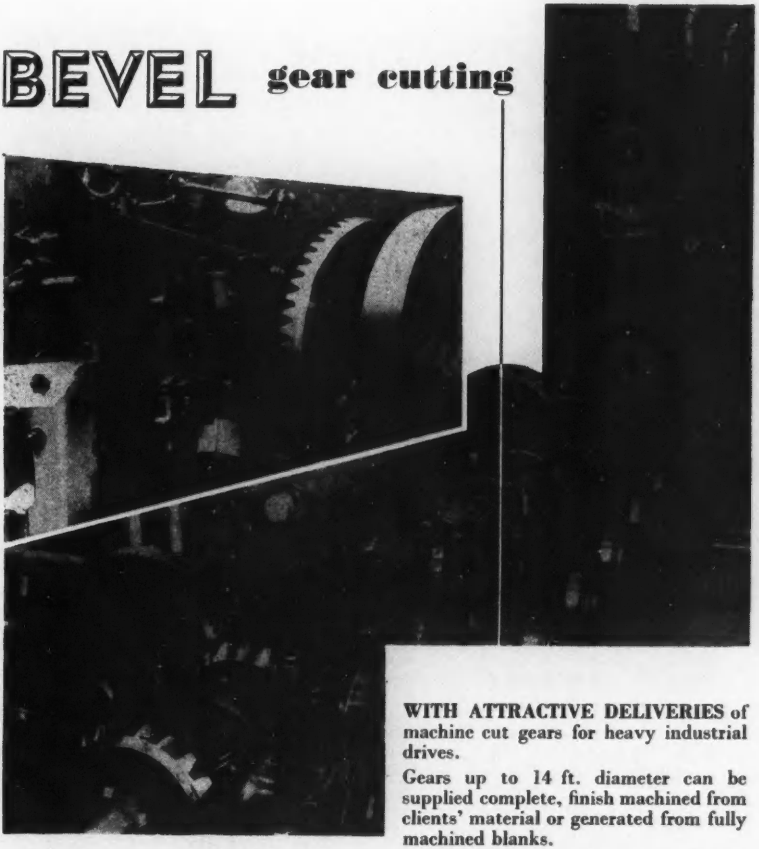

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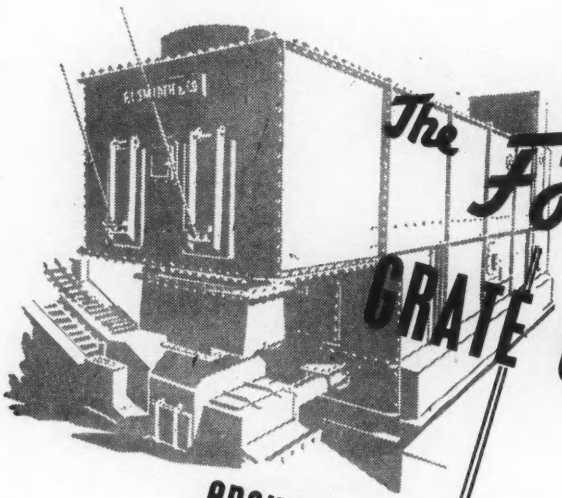

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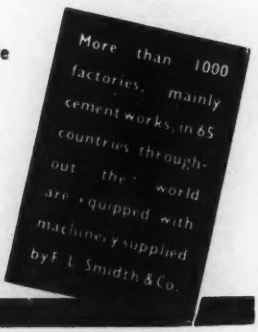
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Absolute Measurement of the Specific Surface Area of Powdered Materials.

BLAINE'S apparatus for measuring the surface area of powdered materials gives comparative results only, that is it must be calibrated against a substance of a known specific surface area. For this reason the results are not very accurate and the use of the method is limited to purposes for which absolute accuracy is not essential. A modification of Blaine's standard procedure, which makes possible the measurement of absolute specific surface area, was recently described by L. Zagar and C. Schumann*, and the results were found to be in good agreement with those given by other absolute methods of measuring surface area.

In the standard Blaine apparatus (*Fig.* 1) the movement of the meniscus of the manometer liquid is given by the equation:

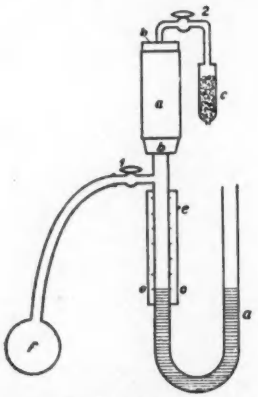
$$B - Q = B.e^{-Kt} \quad \ldots \quad (1)$$

in which B is the distance in centimetres between the highest point reached by the meniscus and its equilibrium position; Q is the volume of air drawn through the bed of the test powder in time t; t is the time in seconds, and K is a constant, specific to each bed of powder. In equation (1), when $t = 0$ (at the beginning of the test), $B = 0$, and as soon as valve 2 (*Fig.* 1) is opened the meniscus of the manometer liquid begins to fall, very rapidly at first and then slower until the establishment of complete equilibrium. If the time required for the equilibrium to be established is infinity then, from equation (1), $B = Q$, that is the whole of the space corresponding to B is filled with air. Using a stopwatch and a scale attached to the manometer, a series of values for $B = Q$ can be determined, together with the corresponding time intervals t for each determination. The constant K is then obtained from equation (1) as in (2):

$$ln\,(B-Q) = -Kt + lnB \quad \ldots \quad (2)$$

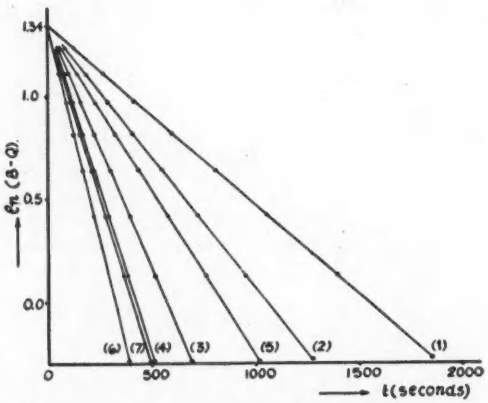
* Zement-Kalk-Gips, 1954, 7 (7).

If now a series of values of $ln(B-Q)$ is plotted against t, a straight line is obtained the slope of which gives the required value of K. Experimental values of K derived from the graph in *Fig. 2* are given in *Table* 1:



a=permeability cell with the bed of powdered material. b=rubber stopper. c=moisture absorbing material. d=dibutylphtalate. e=scale. f=suction device.

Fig. 1.—Blaine Apparatus.



(1) Gypsum No. 1. (2) Gypsum No. 2. (3) Feldspar. (4) Quartz sand (coarse). (5) Quartz sand (fine). (6) Cement No. 1. (7) Cement No. No. 2.

Fig. 2—Determination of Constant *K*.

TABLE 1. VALUES OF K

Test substance	Test		
	I	II	III
Gypsum No. I	0.86×10^{-3}	0.87×10^{-3}	0.79×10^{-3}
Gypsum No. II	1.28×10^{-3}	1.24×10^{-3}	—
Feldspar	2.31×10^{-3}	2.37×10^{-3}	2.37×10^{-3}
Quartz sand (coarse)	3.16×10^{-3}	3.30×10^{-3}	3.53×10^{-3}
Quartz sand (fine)	1.60×10^{-3}	1.61×10^{-3}	1.58×10^{-3}
Cement No. 1	4.06×10^{-3}	4.97×10^{-3}	3.44×10^{-3}
Cement No. 2	3.31×10^{-3}	3.07×10^{-3}	3.62×10^{-3}

The specific surface area of the materials is now calculated from the general formula for the air-permeability method:

$$S = \frac{14}{\rho(1-\epsilon)} \cdot \sqrt{\frac{\epsilon^2 F}{L \eta}} \cdot \sqrt{\frac{\Delta P}{Q}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (3)$$

where ρ is the density of the powder; ϵ is the porosity of the powder bed; F is the cross-sectional area of the powder bed in sq. cm.; ΔP is the pressure difference in the U-tube of the manometer in cm. water gauge; Q is the air flow in cu. cm. per second; η is the viscosity of air in poises (η at 18 deg. C. $= 1.78 \times 10^{-4}$); and L is the height of the powder bed.

In equation (3) only the pressure difference and the volume of air drawn through the apparatus have to be determined experimentally. If all surface area measurements are to be done on one type of substance only, (3) can be simplified by writing:

$$S = R \cdot \sqrt{\frac{\Delta P}{Q}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (4)$$

in which $R = \frac{14}{\rho(1-\epsilon)}\sqrt{\frac{\sqrt{\epsilon^3}\,F}{L\eta}}$.

In the static method of measuring surface area, for example that of Lea and Nurse, pressure difference is constant, and the velocity of the air flow is not required. In the dynamic method, pressure difference is constantly changing, and so is the rate of the air-flow in the apparatus. The instantaneous values of pressure difference can be read easily, but the determination of the velocity of the air-flow cannot be measured directly. One method of solving this problem is by differentiating the equation of motion of the system. Equation (1) then becomes

$$d\,\frac{(B-Q)}{dt} = -K.B.e^{-Kt} .$$

Therefore $$\frac{dQ}{dt} = K.B.e^{-Kt} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (5)$$

$\frac{dQ}{dt}$ is the required velocity of air-flow and ΔP is the pressure difference at time t.

If very accurate results are required, the expansion of air at the moment it leaves the permeability cell should be considered. It has, however, been shown by theoretical calculations that any such correction lies generally within the limits of experimental error, and can therefore be ignored. Before proceeding with the actual assessment of the test results, it must be borne in mind that Blaine's method is applicable to streamlined flow only; Darcy's law, which forms the basis of the method, is not applicable to turbulent flow. In a streamlined flow, the velocity of the air stream is directly proportional to the instantaneous pressure difference, that is the plot of dP/dt against ΔP should produce a straight line. That this is the case is shown by the curves in *Fig.* 3. This method of interpretation of test results has an additional advantage in that it permits of a direct evaluation of an average value of the expression $\Delta P/dQ/dt$, which is required in equation (4).

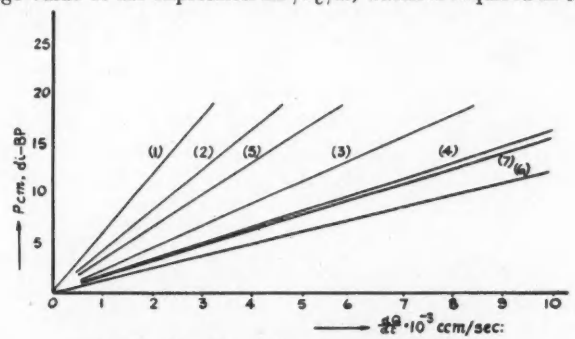


Fig. 3.—Graphs of the Streamlined Flow.

Table 2 gives $\Delta P/dQ/dt$ corresponding to the porosity ϵ of the test-powder bed, and values of the expression R as calculated from the measurements of the permeability cell and the viscosity of air. The experimentally determined values of the absolute specific surface area of a number of substances are given in column four of *Table 2* (expressed in sq. cm. per gramme).

TABLE 2

Material	ϵ	R	$\sqrt{\frac{\Delta P}{dQ/dt}}$	S sq. cm./g.	Average	Variation (Per cent.)	Average error of the middle values (Per cent.)
Gypsum No. 1	0·20	40·32	78·3	3157			
	0·20	40·32	78·0	3145	3182	1·6	0·9
	0·20	40·32	80·5	3245			
Gypsum No. 2	0·21	42·50	64·3	2740	2762	0·8	0·6
	0·21	43·50	65·2	2784			
Feldspar ..	0·26	55·00	47·6	2618			
	0·26	55·00	47·4	2612	2610	0·3	0·2
	0·26	55·00	47·3	2601			
Quartz sand (coarse)	0·20	35·13	40·8	1433			
	0·20	34·93	40·0	1397	1397	2·8	1·6
	0·20	35·00	38·8	1360			
Quartz sand (fine)	0·23	45·10	57·5	2593			
	0·23	45·10	57·0	2570	2593	0·9	0·5
	0·23	45·10	58·0	2616			
Cement No. 1..	0·23	41·00	36·0	1476			
	0·24	43·80	32·6	1428	1462	1·6	0·9
	0·22	37·80	39·2	1481			
Cement No. 2..	0·23	40·90	40·0	1636			
	0·22	37·90	41·5	1570	1625	2·6	1·5
	0·24	43·80	38·2	1670			

In order to compare these results with those of the static method of Lea and Nurse, the same permeability cell was used for the two determinations. A variation in the results was found, but as the results never differed by more than 5 per cent. it can be accepted that the method is reasonably accurate and reliable. If all measurements are of one type of powder only the method can be further simplified by carrying out only one absolute surface area determination and relating to it all subsequent measurements. In this way a specific standard is provided which is free from the usual errors due to differences in the shape and density of the particles and the porosity of the standard and test powders as used in other methods.

To ensure additional accuracy it is also recommended to use a cell c (*Fig.* 1) containing a moisture-absorbing material and a valve 2 between the cell and the powder bed.

Testing the Strength of Concrete by the Ultrasonic-pulse Method.

By R. JONES,* B.Sc., Ph.D., and J. H. WETTERN,† A.M.Inst.T.

THIS article describes the use of the ultrasonic-pulse method to assess the strength of precast units to form sections of primary and secondary beams which were to be assembled and prestressed on the site to form the beams in a new school building. The tests were undertaken at the request of the Ministry of Education and with the co-operation of Messrs. Gilbert-Ash, Ltd., the Prestressed Concrete Co., Ltd., and the Mono Concrete Co., Ltd. The testing was done at the works where the units were made, and 10 per cent. of the total number produced were tested. By this means a stricter control of quality was achieved than would have been possible by usual methods of testing.

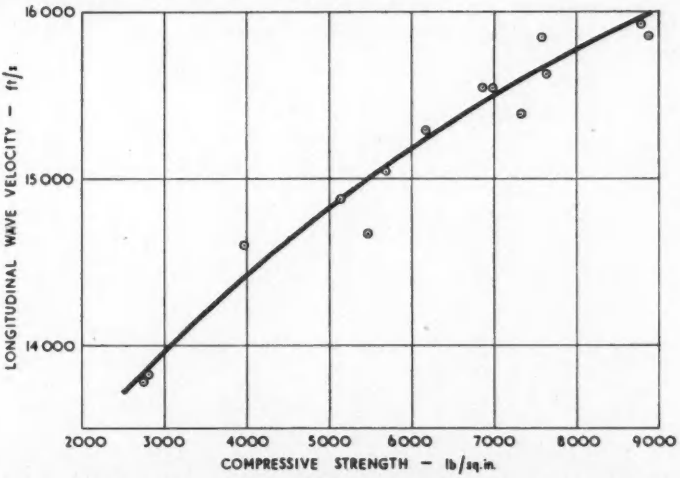


Fig. 1.—Relation between Longitudinal Wave Velocity and Compressive Strength.

The Ultrasonic-pulse Method.

For any concrete there is a simple relationship between the velocity of an ultrasonic pulse in the concrete and its compressive strength[1] [2]. Therefore, if it is required to know the compressive strength, the procedure is to determine the velocity of an ultrasonic pulse in the concrete and to infer the corresponding compressive strength from ancillary data relating the compressive strengths and pulse velocities of cubes made of concrete of the same ingredients and composition. These data are obtained by testing cubes at different ages. *Fig.* 1 shows this relationship for the concrete used in making the units which were the subject of the tests described. By testing cubes at different ages and made from different

* Road Research Laboratory, Department of Scientific and Industrial Research.
† The Mono Concrete Co., Ltd.

batches of concrete, allowance is automatically made for slight variations in proportions which may occur from day to day. If, however, the average proportions of the mixtures are changed, or another type of aggregate is used, a further series of test cubes would be required[1 2].

Method of Testing.

Fig. 2 shows the testing apparatus (which is fully described elsewhere[3]) together with precast units undergoing test. The velocity of the ultrasonic pulse, that is the longitudinal wave velocity, is calculated from the time taken for the leading edge of the pulse to traverse a known length of concrete. The pulse is sent out 50 times per second from a piezoelectric-crystal transducer held in contact with one face of the concrete. After passing through the concrete, the pulse is received by a second crystal transducer which converts the mechanical pulse into a corresponding electrical signal. This is amplified and produces a visual image of the pulse on the trace of a cathode-ray tube. The image passes across the screen in synchronism with the transmitted pulse. Timing-marks also appear on the trace at intervals of ten microseconds. The time of propagation of the pulse is measured by the displacement of the pulse when the transducers are respectively (1) in contact with each other and (2) separated by the concrete. An interpolation device enables the time to be measured to $\pm$ 0·1

Fig. 2.—Testing the Precast Concrete Units.

microsecond, and reading is facilitated by expanding the part of the time-scale in which the signal lies. The thickness of the concrete at each measuring position is determined with the aid of calipers.

The units (*Fig.* 2) were 3 ft. 3 in. long and $7\frac{1}{16}$ in. wide across the bottom flange. The concrete in the bottom flange required the most careful examination since this part sustains the highest initial stresses. Analysis of a large number of measurements showed that the mean result from three standard positions was within $\pm$ 1 per cent. of the true mean time of transmission. A standard procedure of test was therefore adopted, consisting of taking three measurements directly across the $7\frac{1}{16}$-in. dimension (one measurement near each end and one at the middle).

Initially it was desired that every unit be tested, but as a result of extensive preliminary measurements it was found that sampling methods could be employed. The decision to test 10 per cent. of all the units produced proved satisfactory both from a practical and from an experimental point of view.

In order to keep handling costs low the testing apparatus had to be as near as possible to the stacking area, and the instrument was therefore housed in a small weatherproof building close to the casting shop. Access was by double doors on opposite sides of the building, which enabled a roller conveyor carrying the units to pass through. The apparatus was operated by the staff of the Mono Concrete Co., Ltd., and Messrs. Gilbert-Ash, Ltd., and the testing was fitted into normal factory routine.

One unit from each batch was set aside when it was removed from the mould and placed close to the testing machine. As the units attained the necessary age they were prepared for testing in batches of about a dozen. Preparation consisted of numbering the units for record purposes, cleaning, and applying soap-jelly to the surface in the positions at which the transducers were to be applied. Particles of grit and air bubbles, if allowed to come between the transducers and the concrete, tend to cause distortion of the cathode-ray trace; carborundum stone and a clean rag ensure the necessary smooth surface. The soap-jelly provides a coupling between the transducer and the concrete; this was as effective as the oil normally used and did not stain the concrete.

Before each day's testing a measurement was made on an aluminium proving-block through which the time of transmission of the ultrasonic pulse was accurately known. This enabled the operator to ensure that the apparatus was working satisfactorily. *Fig.* 2 shows a test in progress. An assistant holds the transducers in firm contact with the concrete while the operator observes the cathode-ray trace and records the reading. The rate of progress was governed more by the time required for handling and preparing the units than by the time taken in actual testing. The average rate was about twenty units per hour.

The specification required the cube strength of the concrete to be at least 6,500 lb. per square inch at 28 days. The first measurements of pulse velocity showed that some of the units would have a somewhat lower equivalent cube strength at this age. The units were designed for a total load of 18 tons on the

flange, including the factor of safety. Compression tests showed that units failing under this load would have strengths corresponding to a pulse velocity in the flange of 14,600 ft. per second (*Fig.* 3). To provide a slight additional margin, 14,800 ft. per second, corresponding to an equivalent cube strength of 5,000 lb. per square inch, was chosen as the acceptance figure.

Test Results.

The first 200 units tested were cast and cured between July and December, 1953, when the weather was relatively mild. Subsequent units were cast and cured in January, 1954, when severe frosts occurred. The apparatus was not available until late in November, 1953, so that some of the first 200 units were considerably over-age at the time of test. The results from these units were adjusted to relate to an age of 28 days by using additional data obtained from ageing tests on cubes.

The distribution of the longitudinal wave velocities in the units tested before 1 January, 1954, is given in *Fig.* 4. The results are on a normal distribution curve except for ten units which gave abnormally low values between 14,500 and 14,700 ft. per second. These were all cast, although not necessarily tested, on the same day. For the normal part of the distribution the mean value of the equivalent cube strength was 6,300 lb. per square inch and the standard deviation ± 500 lb. per square inch. Analysis of results obtained on cubes during the same period gave a mean strength of 7,750 lb. per square inch and a standard deviation of ± 750 lb. per square inch. As expected, the strength of the concrete in the flange of the unit was slightly inferior to that in the corresponding test cube, but generally much higher than the acceptance strength. The variability, however, was similar and it is concluded that the main fluctuations in strength were due to variations between the different batches of concrete.

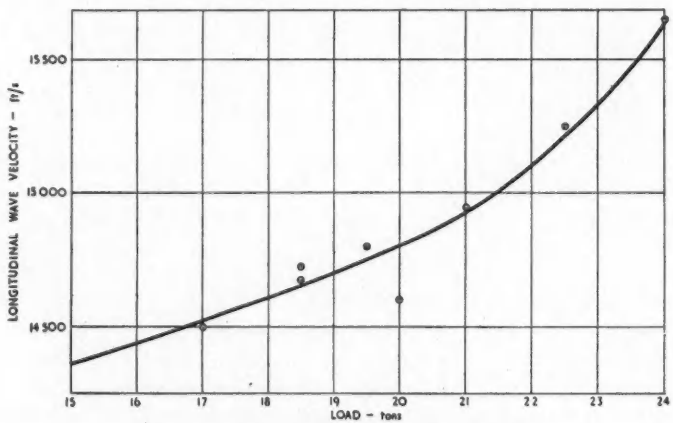


Fig. 3.—Results of Compressive Tests.

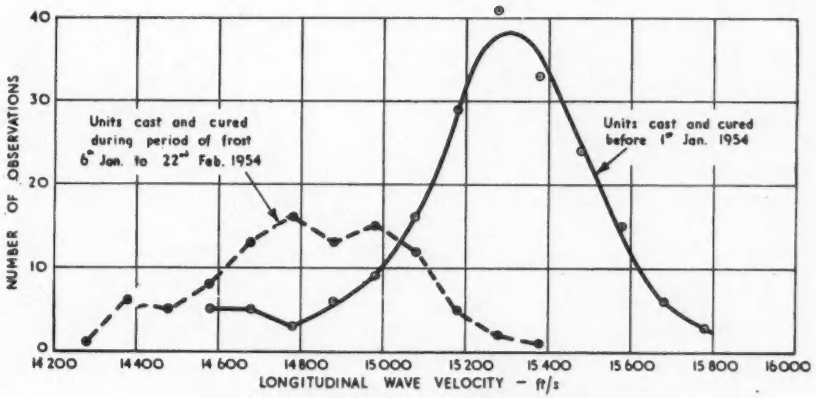


Fig. 4.—Distribution Curve of Mean Results.

Results obtained from a further 97 units cast and cured during the intermittent frosts of January and February, 1954, are also given in *Fig.* 4. The strength of this concrete was appreciably less than that of the previous batch and there was wider variation. The difference is almost certainly due to the low temperatures, which delayed the hydration of the cement and reduced the rate of increase of strength. Subsequent tests on these units, following a period of thaw, showed when the required strength had been attained. Under favourable curing conditions the specified strength (the strength required before applying the prestressing force) can be attained at an age much less than 28 days. Thus, when an early delivery was required, ultrasonic tests showed whether units of an age less than 28 days could be used.

The authors acknowledge the help given by members of the staff of the Prestressed Concrete Co., Ltd., Messrs. Gilbert-Ash, Ltd., and the Mono Concrete Co., Ltd. The article is published by permission of the Director of Road Research, Road Research Laboratory, and the Directors of the Mono Concrete Co., Ltd.

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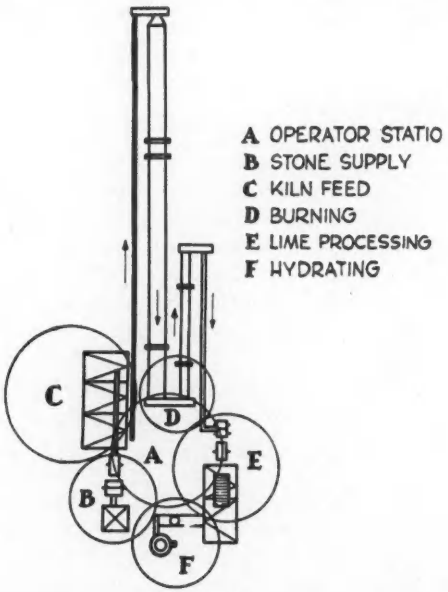
(2) JONES, R. Testing concrete by ultrasonic pulse technique. *Proc. Highw. Res. Bd., Wash.*, 1953, **32**, 258–75.

(3) GATFIELD, E. N. An apparatus for determining the velocity of an ultrasonic pulse. *Electron. Engng.* 1952, **24**, (295) 390–5.

Planetary Arrangement of Lime Kilns.

WHAT is called a " planetary " system of arrangement of small rotary lime kilns is described by Mr. Wolf G. Bauer in " Pit and Quarry " for May, 1955. A small kiln is one within 5 ft. to 7 ft. diameter by 80 ft. to 130 ft. long, carried on two tyres and having an output of 25 to 75 tons a day, and the author claims that such kilns are as economical in production as shaft kilns.

In describing the planetary arrangement, the writer states that compactness and centralisation of supervision, even with small kilns, is seldom achieved, and they are generally arranged in either straight-line or L-shaped pattern. In the



planetary arrangement all the processes and machines are directly seen, operated, and supervised by one man from the central plant control position. *Fig.* 1 shows small rotary kilns and ancillary plant in a planetary arrangement. The kiln-firing floor is part of a larger floor area, and each side of this floor forms the starting and end-point of a processing stage. In front of each stage in the process is a control panel with the corresponding switch-boxes and starters.

The stone is delivered to the kiln by a belt conveyor parallel to the axis of the kiln. If no further kilns are to be added later, the kiln-feed bins and feeder can be as shown in the illustration. If room is to be left for future kilns, the bins and feeder are farther back, nearer the centre of the operating station. The other processes are arranged in groups radially in sequence around the control station. The stone-receiving, and perhaps the kiln-preparation, stage (including crushing

and screening if stone is received unsized) are directly behind the kiln-feed bins. The cooler is parallel to the kiln in order to allow the cooled lime to be taken to the control station prior to crushing. This arrangement permits continuous inspection of the lime and can be arranged with any type of cooler.

The crusher and crushed-lime bins are on the same side of the station, while the hydrator, dust washer, hydrate feeder, and process mill, etc., are close to the operating station. Small intermediate levels, extensions, or mezzanine floors may be arranged around the operating station area, but heights of feed-points and process-access points are designed to fit into the operating station area. If this design is basically followed, many minor innovations can be incorporated, such as visual and sample-testing points, a lighted board with a painted flow-sheet diagram to show the material flow or bin level, splitgate position indicators, testing equipment, instruments and controls, firing report chart, material-flow counters, and so on. It is not much more difficult to design in planetary style than it is to follow the conventional arrangement, nor is the cost necessarily higher. The potential operating advantages and cost savings, however, include the following: The flow of material, feed transfer, process changes, and control points are under direct observation at all times; it is unnecessary for the operator to be out of sight of any of the manufacturing stages in order to attend or adjust any one; better use is made of the site, and the plant can be extended without altering the position of the operator. It is stated that this arrangement has given satisfactory results at a mineral processing plant recently designed by the writer.

Cement Works Expansion in Siam.

The Export-Import Bank of America has granted a credit of $1,250,000 to the Siam Cement Co., Ltd., for the extension of its works by the purchase of equipment from the U.S.A. It is proposed to increase the capacity of the works by about 15,000 tons of cement a month.

Cement Production in French Morocco.

The starting of a new kiln at the Casablanca Cement Works has increased the capacity of the cement works in French Morocco to 600,000 tons a year, which equals 90 per cent. of the demand.

New Cement Works in Lebanon.

A new cement works with a capacity of about 70,000 tons a year started production in March last.

Increased Production of Cement in Pakistan.

In the year 1954 more than 666,000 tons of cement were made in Pakistan. This compares with 596,000 tons in the previous year, 530,000 tons in 1952, and 499,000 tons in 1951. New cement works at Daud Khel (Punjab) and Hyderabad are expected to be in production by the end of 1955.

The Associated Portland Cement Manufacturers, Ltd.

THE following is abstracted from the address of the Chairman, Sir George Earle, C.B.E., at the annual general meeting of the stockholders of the Associated Portland Cement Manufacturers, Ltd., held in London last month.

The trading surplus increased by £1,894,000 to £11,053,000, being helped by the fact that in 1953 it was necessary to import cement to sell at the home trade price, involving a loss of over £800,000. The sum of £3,578,000 (£690,000 more than last year) was set aside for depreciation and replacement of plant and machinery. Provision for taxation increased by £636,000 to £3,984,000. After deducting transfers to reserves, etc., amounting to £2,300,000, there was left for the stockholders £154,000 more than last year. The tax paid per pound invested in the business was now 94 per cent. higher than pre-war, wages were up by 173 per cent. and coal by 271 per cent., but the home trade price of cement had increased by only 130 per cent. and was still the cheapest in the world.

OVERSEA WORKS.—In Australia the second wet-process kiln was working well and the 1954 results were much better than those for 1953. The mechanisation of the colliery was now practically complete. The paper bag company, in which the Australian Company had a large interest, was building a factory in Sydney, while the Melbourne factory was being modernised and a small bag factory in Perth would be in production this year.

In Canada the demand in British Columbia was not sufficient to keep the works on full output, but thanks to the considerable expenditure on new plant at the works they were able to keep their costs to a reasonable level and to produce satisfactory results. The demand there had now improved.

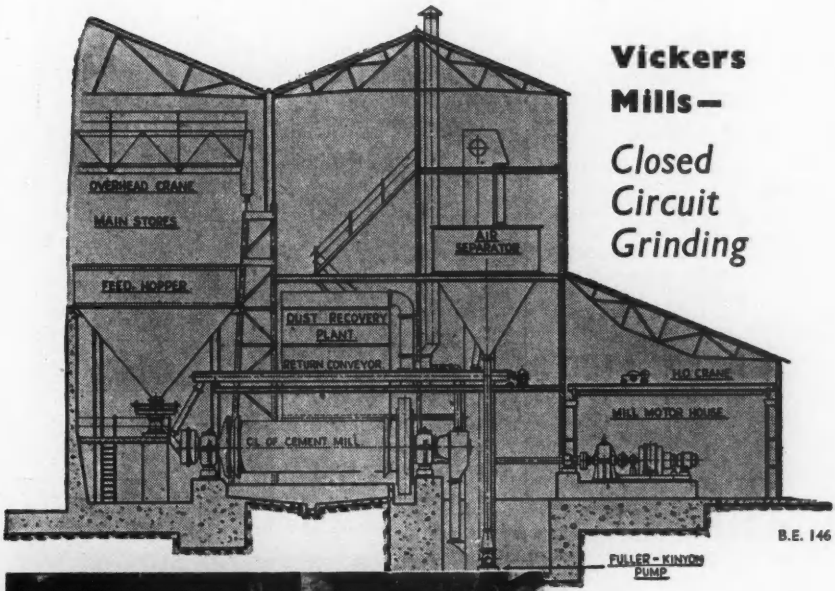
The construction of a new works, with a capacity of 100,000 tons a year, near Nairobi, by the East African Portland Cement Co., Ltd., had started.

The Malayan Company, in its first full year of working, paid a dividend of 2½ per cent. They had started the new year very well, and hoped for much better results in 1955.

In Mexico the devaluation of the peso, apart from reducing the value of dividends by 44 per cent., resulted in a large increase in the cost of labour and fuel, which so far had not been balanced by any increase in the selling price. The demand also dropped. The prospects at the moment were not particularly encouraging, and it was extremely disappointing that, owing entirely to these causes which were outside their control, the very fine factory at Tolteca had not yet produced the results it otherwise would have done.

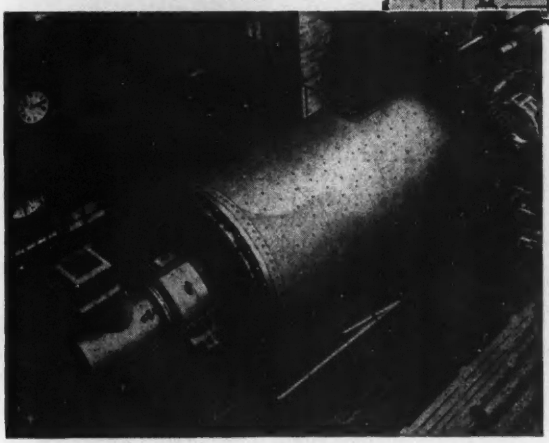
The M.V. " Golden Bay " was now in New Zealand. This ship was designed for carrying loose cement and coal. It seemed probable, however, that owing to the increased output of the works in New Zealand she would not have much, if any, time for carrying coal. Silos and packing plant had been built at Wellington and similar plants were to be built at Wanganui and Tarakohe. Plans for increasing the output of the works were under consideration.

In South Africa the third large kiln at Lichtenburg should start in August.



Vickers Mills—

Closed Circuit Grinding



Though a 'closed circuit' makes it easier to control production to a specific fineness, consistent accuracy depends upon the plant being reliable. The trouble-free running synonymous with Vickers mills demonstrates, in fact, that there is no substitute for skill and experience backed by manufacturing capacity.

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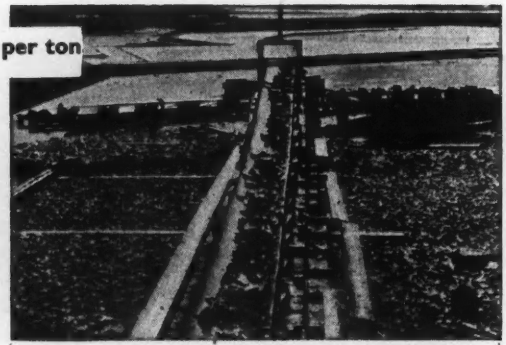

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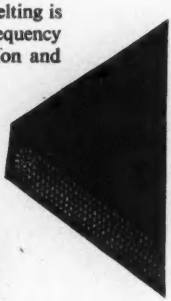

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

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White's South African Portland Cement Co., Ltd., had a very good year. A new works outside Salisbury in Southern Rhodesia was to be built for the Salisbury Portland Cement Co., Ltd., their latest oversea investment. They hoped production would start in 1956.

HOME WORKS AND TRADE.—During 1954 the Company produced record quantities of cement at home, and also of many of its other products, while other makers increased their production substantially; it was thus possible to avoid the importation of foreign cement. This year they hoped to show even better figures of production from their own works, and in addition there would be cement coming from Widnes and Whitehaven where new sulphuric acid plants were being erected. The recently announced road programme would require additional quantities of cement in the next few years and he was confident that the cement industry as a whole would have no difficulty in meeting all demands arising from this source. They were maintaining their share of sales in the world markets, and despatches so far this year reflected the steadily expanding needs of their customers.

The building of the new works at Cauldon in Staffordshire had been disappointingly slow, but the work was now well in hand and progress should be satisfactory. The cost of this works would be about £3,000,000 for an annual output of 175,000 tons. It was obvious that this works alone would not be an economical proposition, as their small profit margins would be nearly all absorbed by depreciation charges. Fortunately, they hoped to make considerable savings in the cost of delivery of the cement which now supplied the market for which Cauldon would cater in the future, but even under these conditions the investment was not attractive. However, they considered that they must build this works because, as the largest manufacturers in the industry, they had special responsibilities to keep the market supplied.

Last year he reported that they were about to build a works at Westbury in Wiltshire, and preliminary work on the site was now complete. They now hoped, however, that it might be possible to increase the output from their existing works by more than the proposed output at Westbury at a much smaller capital cost. They did not yet know if this idea would be a success, but they would know this year, and in view of what he had said about the investment at Cauldon it was obviously wise to wait and see at Westbury.

They were constantly having to carry extra costs, but since March last year they had been able to avoid increasing prices. It was questionable, however, whether they would be able to so absorb the increase in the price of coal which was shortly to be made. Apart from its very high price, they were involved in great expense owing to the varying quality of the coal they were obliged to buy. The variation in quality got worse every year. This was a serious trouble and one which they did not have to bear in pre-nationalisation days.

Their expenditure on research on methods of manufacture and on the quality of their products was increasing; in 1954 it amounted to £252,000.

Polyvinyl Acetate Emulsion as an Addition to Cement.

THE addition of polyvinyl acetate emulsion to Portland cement has been found in the United States to improve some of the properties of Portland cement mortars. Experiments made at the Department of Chemical Engineering of the Massachusetts Institute of Technology showed that the addition of 1 part by weight to 5 parts of Portland cement produced the following results.

(1) The tensile strengths of mortars cured in a dry atmosphere were three to four times those of plain cement mortars cured in a fog room and eight to ten times those of plain cement mortars cured in a dry atmosphere.

(2) The elongations at rupture of tensile specimens cured in a dry atmosphere were about twenty times the elongation at rupture of plain cement mortars cured either in a dry atmosphere or in the fog room.

(3 The compressive strengths of mortars cured in a room at 50 per cent. relative humidity were only 70 per cent. of the strength of plain cement mortar cured in a fog room but more than three times that of plain cement mortar cured in a room at 50 per cent. relative humidity.

(4) For specimens cured in a dry atmosphere, the strength of the bond to steel was one-and-a-half times and the strength of the bond to concrete surfaces was ten times that of plain cement mortars cured in a dry atmosphere.

(5) Since 50 per cent. relative humidity at 70 deg. Fahr. approximates to usual indoor drying conditions, the mortar can be left to set and harden by itself, without the wetting required for plain cement mortars to obtain high strengths. This was confirmed by the strength of the tensile specimens cured in a room with relative humidities varying from 25 per cent. to 45 per cent. with temperatures varying from 65 deg. to 85 deg. F.

(6) The mortar containing a polyvinyl acetate to cement ratio of 0.2 was more workable and flowed more easily than did plain cement mortars with the same water to cement ratio. It did not require the extra tamping and ramming essential to compact the plain mortars. The water to cement ratios in most of the tests were 0.6 for compressive cubes and 0.43 for tensile briquettes. Decreasing the water content within the limits of workability increased the tensile strength of mortars containing polymer. This was not possible with the plain cement mortar which was at the lower limit of workability.

(7) The modulus of rupture for the mortar cured in the room at 50 per cent. relative humidity was forty times that of plain mortars cured in the fog room. The impact strength of mortars cured in the fog room was 20 per cent. more than the impact strength of plain mortars cured in the fog room.

(8) Mortars cured in a fog room when compared with plain cement mortars cured in a fog room had about ten times the resistance to abrasion, at least the same resistance to freezing and thawing, and the same or greater resistance to corrosion by alkali, organic solvents, and dilute inorganic acids. They were

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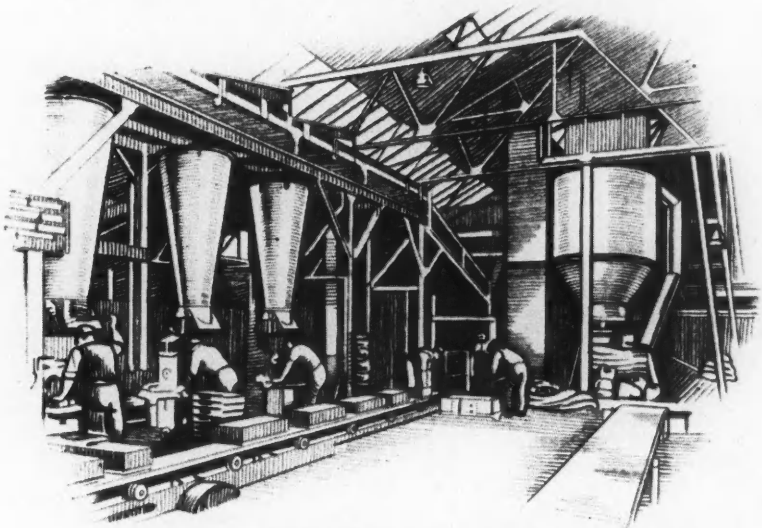

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Qualifications:

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(2) Five to ten years' practical experience in engineering concerns of which at least three years should be in a responsible position. Cement Works experience preferred.

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(2) When joining duty, free ordinary first-class sea passage for self, wife, and dependent children below 15 years age, plus similar free sea passage while proceeding on leave after three years' service.

(3) In addition to Salary and Overseas Allowance, other benefits include rent-free furnished house, dearness allowance, annual bonus depending on Company's profits, Provident Fund, etc., according to Company's rules.

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more resistant to concentrated hydrochloric acid, but less resistant to boiling water.

It is claimed that one of the outstanding results of the investigation is that the Portland cement mortars containing polyvinyl acetate emulsions have maximum improvement in properties when cured in air at ordinary temperatures and humidities. This self-curing, combined with improvements in tensile and bond strengths, extensibility, and resistance to abrasion, impact, and corrosion, makes this material very interesting as a possible means of improving some of the qualities of Portland cement mortars.

It is said that among the uses for which this material may offer particular advantages are (1) Floor toppings and road surfaces for which greater tensile and impact strengths, greater resistance to abrasion and corrosion, and increased resiliency offer a considerable resistance to cracking; (2) Wall and ceiling plasters where increased bond strengths and increased resiliency, combined with self-curing properties, are advantageous; (3) Masonry surfaces where self-curing and bond strengths are advantageous; (4) Limited structural uses, such as for tanks and pipes, where tensile strength is important.

The polyvinyl acetate to cement ratio of 0.2 which produces the optimum physical properties is the most workable mixture. It is probable that because of the excellent workability the physical properties can be further improved by decreasing the water-to-cement ratio.

The process is being developed in the U.S.A. by the Borden Company of Peabody, Mass., and the British licensees are Messrs. Scott, Bader & Co., Ltd., of Wellingborough.

New Cement Works in Spain.

The firm of Ferrdand, S.A., of Bilboa, has received permission to build a factory at Sagunto, Valencia, with an annual capacity of 40,000 tons of metallurgical cement and 20,000 tons of special cement.

Production of Cement in Greece.

On the occasion of the sailing of a ship with 9,400 tons of cement for Saudi Arabia, the Greek Minister of Commerce said that cement production in Greece increased from 278,000 tons in 1948 to 860,000 tons in 1954 and was expected to be as large as 1·1 million tons in 1955. Exports at present were about 25 per cent. of the total production, and for 1955 were expected to be 250,000 tons valued at about $3,000,000.

Cement Production in Angola.

The production of cement in Angola, Portuguese West Africa, in the year 1954 was 32,162 tons, an increase of 13,472 tons compared with 1953.

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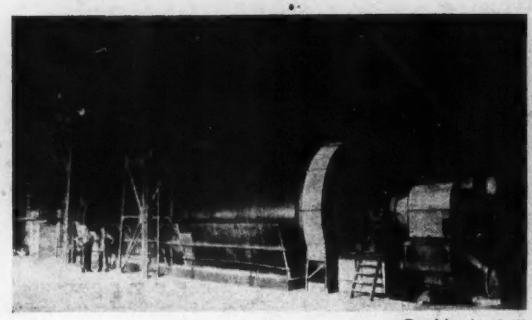

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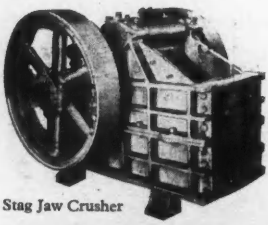
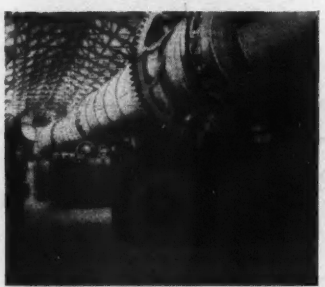


Stag Jaw Crusher



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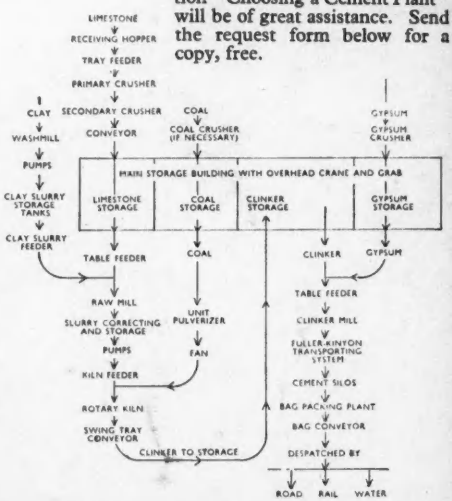

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